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Commodity Exports and Real Income in Africa

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and
Maurice Schiff

In providing policy advice and support of investment projects for commodities such as cocoa, the donor community should take into account the effects on, and possible reactions of, the other countries producing that commodity.

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This paper — a product of the Trade and Policy Division, Country Economics Department — is part of a larger PRE effort to examine the question of whether the simultaneous expansion of exports by several developing countries would lead to a decline in their terms of trade, export revenues, and real income. Copies are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Sheila Fallon, room N10-025, extension 38009 (37 pages, with tables).

It has often been argued that if several developing countries expand exports, they are likely to experience a decline in their terms of trade, export revenues, and real incomes. The general case for this export pessimism has lost much of its force, but remains very much alive for some specific countries and commodities — particularly the export from Africa of cocoa, coffee, and tea, which exhibit low price elasticity.

Panagariya and Schiff systematically analyze this issue for cocoa, a commodity for which many African countries have a large share in world exports. Their concern is chiefly with the problems that arise from low price elasticity of demand in the world market and their implications for trade policy.

They find that increasing productivity in one African country through new investments would benefit that country — but the other African countries would lose. On the whole the African countries would gain, however, so the gains to the country with expanded output would dominate the losses for the other countries. The return on the new investments for Africa as a whole would be positive — although significantly lower than returns for the country in which the new investments were made.

Panagariya and Schiff:

- Examine how real incomes and tax and export revenues compare under existing and some alternative (Nash, myopic) taxes.

- Analyze the impact of export expansion (through increased efficiency) on real income, export revenues, and tax revenues, under alternative tax regimes.

- Compare the effects of export expansion by African countries with that by non-African countries.

Their results — highly tentative — are based on calibrated equilibria that use specific functional forms and existing point estimates of various elasticities.

Commodity Exports and Real Income in Africa*

by
Arvind Panagariya
and
Maurice Schiff

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COMMODITY EXPORTS AND REAL INCOME IN AFRICA *

I. INTRODUCTION

A. The Problem

This paper is part of a project whose principal objective is to address the frequent concern that a simultaneous expansion of exports by several developing countries is likely to lead to a decline in their terms of trade, export revenues and real income. This concern dominated the writings of development economists during the 1950s and has kept resurfacing in one context or another ever since. The essential argument as expounded in the early writings - e.g., Prebisch 1950, - was that exports of developing countries consisted mainly of primary products for which world demand was inelastic. Therefore, any productivity gains in exportables were likely to be passed on to importing countries via a change in the terms of trade favorable to the latter. There was little to be gained by relying on exports as the engine of growth.

A number of economists, including Krueger (1961), Cairncross (1962), Keesing (1967), Balassa (1978) and Bhagwati (1978, 1988), refuted the wisdom of this export pessimism. In particular, the recent paper by Bhagwati (1988) provides a comprehensive review of the controversy and makes a convincing case that the fears of elasticity

* We would like to thank Shantayanan Devarajan for useful comments and Brendan Kennelly for excellent research assistance.

pessimists, old as well as new, are ill founded. Among other things, he points to the phenomenal growth of exports and incomes of many East Asian countries to counter export pessimists. He also argues that the dramatic shift in the export composition of developing countries toward manufactures and the potential for intraindustry specialization provide further reasons why the world demand is unlikely to be a binding constraint in the future.

The general case for export pessimism has lost much of its force, at least for now. Concerns have remained very much alive, however, with respect to some specific countries and commodities. Thus, fears continue to be expressed that a simultaneous expansion of exports of certain commodities (e.g., cocoa, coffee and tea) by several African countries, most recently resulting from the adoption of structural adjustment programs, may lead to a decline in the real incomes and exports revenues of the countries. These fears have been sufficiently serious that since 1968 the World Bank has had special lending guidelines for commodities such as coffee, cocoa and tea. Bank policy is to deny lending for output expansion of these commodities, unless the country has no viable economic alternative or if the country has suffered a recent loss in production due to climatic or other reasons.

Concerns regarding possible harmful effects of commodity export expansion have reemerged recently in the context of structural adjustment both within and outside the Bank. For instance, such concerns were raised recently in the German parliament which, in turn,

prompted the German Executive Director at the World Bank to send the following query to the World Bank's Chief Economist for Africa:

> "In the framework of structural adjustment programs, many African countries endeavor to increase their exports of agricultural products. An increased supply of goods may soon lead to price declines of the correspondent products, so that additional revenues may not be realized. How does the World Bank justify its correspondent policy advice? What can be done to avoid the negative results?"

A similar sentiment has been expressed by Professor H.W. Singer in an exchange with Mr. C. Humphreys in the December 1989 issue of Finance and Development. Professor Singer asserts that the "adverse changes in terms of trade, far from being 'exogenous', are related to the export expansion. . . recommended simultaneously to indebted countries". In response, Mr. Humphreys writes that the argument of the negative effect on the terms of trade of export expansion is weak, and suggests that Africa should raise productivity in its traditional exports, diversify its export base, and expand production of imported commodities. Perhaps there is some truth in both views but without systematic analysis we cannot reach a consensus.

The recent World Bank Board paper "Strengthening Trade Policy Reform" also emphasizes the need for studying the effects of increased commodity exports on the terms of trade and real incomes in Sub-Saharan Africa. Similarly, the study on Africa by Landell-Mills, Agarwala and Please, "Sub-Saharan Africa: From Crisis to Sustainable Growth" notes

that some of the poorest African countries have been hit hardest by adverse terms of trade changes over the past 30 years.

These examples show that the fears raised by elasticity pessimists are very much alive in the context of African commodity exports. The problem is viewed as being especially serious for countries whose exports are concentrated in commodities that are said to exhibit low import demand elasticities (e.g., Cote d'Ivoire which exports coffee and cocoa). Rhetoric has been strong on the part of proponents as well as opponents of pessimism. But evidence provided to date on either side is sketchy. We believe that there is a real need to study the issue in depth and understand whether the export pessimists are justified and if so what can be done to maximize these countries' gains from exports. The present paper is a first effort in this direction.

Given the low price elasticity of world import demand, an increase in exports of coffee, cocoa and tea will lead to lower overall export revenues. However, some countries may gain. The distribution of gains and losses are examined in detail in the paper.

A central premise behind the paper is that domestic-policy instruments should be employed to promote efficiency at home while trade policy instruments should be used to deal with problems related to foreign demand.[1] Thus, the policy measures designed to correct domestic price distortions and real wage and exchange rate misalignment are well advised. The issue which deserves closer scrutiny, however, is whether

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[1] This view derives from the theory of the second best which emphasizes that distortions should be attacked at the source. See Bhagwati (1971) for further details.

the current trade taxes adequately handle the problems which arise from low demand elasticities in the world market.

There are two analytically distinct sources of terms of trade deterioration: exogenous deterioration due to low income elasticity of demand and endogenous deterioration resulting from increased productivity. In the latter case, increased productivity may be accompanied by a decline in income and export revenues if the price elasticity of demand is low. Our concern here is solely with the problems which arise from a low price elasticity of demand in the world market and their implications for trade policy. Problems which arise from low income elasticity do not require policy intervention and will not concern us here.[2]

Given a low price elasticity, problems can arise at both the national and international level. Thus, export expansion by one country affects not only its own income but that of the other countries as well. In particular, if export expansion is the result of increased productivity, the country expanding exports is likely to gain while the other exporters will lose. The project will study the effects at both levels.

In this vein, we would like to seek answers to the following questions in this project:

1. What is the likelihood that export expansion resulting from better and fuller use of resources can lead to a decline in real incomes and export revenues in African and non-African countries? For which commodities is this

[2] See Bhagwati (1988) on this issue.

outcome plausible? What are the key parameters determining the impact of export expansion on the terms of trade, export earnings and real incomes?

2. Will further reductions in export taxes lead to an increase or decrease in real incomes? What will be the impact of tax reductions on tax revenues and output quantities?

3. Empirically, how important is the issue of interdependence? For instance, while considering a further tax reduction on cocoa, should Ghana pay attention to policy changes in Cote d'Ivoire and Malaysia? In which commodities, if any, does interdependence play an important role?

4. Can countries realize most of the gains from trade by choosing taxes optimally in an independent fashion?

In terms of development of theory, we should note that the issue of income- and revenue-maximizing exports taxes when two or more countries compete against each other in the world market for the same commodity has simply not been studied. The traditional literature deals with the situation in which two countries choose taxes on <u>each other's</u> exports so as to maximize income (welfare) or revenue[3].

[3] For example, see the classic article by Johnson (1954) and the more modern treatment in Dixit and Norman (1980, Ch. 6).

B. Relevant Commodities and Countries

Commodities that concern us must satisfy two important criteria. First, they must account for a significant share of exports of one or more African countries. Second, African countries must have a large share in the world market for those commodities. The six most important commodities based on these criteria are cocoa, coffee, tea, cotton, tobacco and groundnuts. Of these, the first three - cocoa, coffee and tea - are exported exclusively by developing countries while the last three are exported by both developing and developed countries. Developing countries do not import cocoa at all and account for only 7.9 percent of net imports of coffee. The remaining commodities are imported by developing countries in large volume both in absolute and relative terms.

Africa's share in the world market for cocoa is larger than that for any of the other commodities. Côte d'Ivoire and Ghana each has a large share in the world market and depends heavily on this commodity for export receipts. The two countries also raise substantial tax revenues from this commodity. Coffee is the next most important commodity for Africa. Once again, Côte d'Ivoire is the largest African exporter. In terms of export share for Africa, tea ranks behind coffee, with Kenya being the largest African exporter.

Our focus in this paper is on cocoa. Cocoa is not only the most important commodity export from Africa, but it also provides a clean case in that it is exported exclusively by developing countries and imported exclusively by developed countries. Tea and coffee, on the other hand, are also imported by some developing countries and raise

complex distributional issues within developing countries. These commodities will be examined at a later stage.

Cocoa is exported in large amounts by non-African countries as well. We will incorporate explicitly these non-African countries into the analysis. This will allow us to examine the impact on African countries of changes occurring outside Africa, and vice versa.

The remainder of the paper is organized as follows. In Section II, we outline the model and its application to cocoa. In Section III, we present results of a number of simulations. Finally, in Section IV, we conclude the paper.

II. THE MODEL

Our model consists of a multi-country demand-supply system for the commodity examined. The effects of adjustment programs are captured by parameters of the supply function. For instance, improvements in productive efficiency via fuller and better use of resources are represented by shifts in the intercept and/or slope parameters.[4]

Within a partial equilibrium framework, the principal theoretical issue is the determination of income- and revenue-maximizing export taxes when two or more countries compete against each other in the world market. Although there is a large body of literature on optimal trade taxes, the issue of how such taxes are determined when two or more countries compete against one another has simply not been addressed. In

[4] If we feel that general equilibrium analysis may be useful, we will engage in such an exercise in the future. This may be the case if we want to include the implicit tax on exports due to tariffs on imported manufactures (Lerner Symmetry Theorem).

this set-up strategic considerations inevitably come into play. Fortunately, there have been important developments in the area of strategic trade policy in recent years which allow us to address the problem in a reasonable way.[5]

The analytic solution for income- and revenue-maximizing export taxes for several countries who compete in the world market is provided in Panagariya and Schiff (1990). Below, we present a brief diagrammatic exposition of the basic model and its application to cocoa. In the following section, we present the simulation results with actual and income-maximizing taxes. Simulation exercises with revenue - maximizing taxes will be taken up at a later stage.

The basic structure of the problem can be explained conveniently with the help of a three-country setup. Denote the three countries by A, B and C and assume that the former two export cocoa to the latter. Assume that exporters do not consume and the importer does not produce cocoa. Individual producers and consumers are perfectly competitive. Each exporting country's government chooses the export tax so as to maximize the country's profits taking the other exporting country's tax rate as given. This behavioral assumption leads to what is called the Nash equilibrium in the game theory literature.[6]

Consider country A's problem. For a given export tax by B, say t_B, A's government must choose t_A so as to maximize profits from exports. We can obtain the excess demand facing A by subtracting B's

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[5] For a survey of recent game theory models, see Dixit (1986) and the references therein.

[6] We assume that the importer, C, does not levy import tariffs.

supply from the world (i.e., country C's) demand. This excess demand curve is represented by $D_A(t_B)$ in Figure 1. Coresponding to D_A, we can draw a marginal revenue curve, MR_A.

We assume that the supply curve, S_A, reflects the true marginal social costs of producing cocoa in A. Then the country's income-maximizing equilibrium will coincide with the profit-maximizing equilibrium. This equilibrium is given by the intersection of S_A with the MR_A curve. The corresponding world and domestic prices are given by P^W and P_A and the difference between them, $P^W - P_A = t_A P^W$, equals the per-unit export tax. Tax revenue and producers' surplus, respectively, are given by $P_W NMP_A$ and $P_A ME$. In this paper, we will refer to the sum of these areas as the country's profits from cocoa exports.

An increase in t_B shifts B's supply curve (not shown in Figure 1) to the left and hence A's excess demand curve to the right. This causes the optimal t_A to change. It is easily shown that as t_B rises, the optimal t_A also rises. Moreover, A's profits associated with the higher (t_A, t_B) combination are higher as well.

In Figure 2, curve R_A shows country A's optimal tax rate for different values of t_B. In Panagariya and Schiff (1990), we demonstrate that if demand and supply curves are linear, the shape of R_A must be as shown in Figure 2. Analogously to R_A, we can derive R_B which shows the optimal values of t_B for different values of t_A. We will refer to R_A and R_B as reaction curves and to the point of their intersection, N, as the Nash equilibrium.

Suppose that B's tax happens to be t^1_B. The corresponding optimal tax for A, as shown by its reaction curve R_A, will be $\tilde{t}^1_A$. We refer to

$\tilde{t}^1_A$ as A's "myopic" optimal tax to emphasize that $\tilde{t}^1_A$ is optimal only if A expects B to continue to hold its tax at t^1_B. As R_B shows, when A's tax is at $\tilde{t}^1_A$, B's income - maximizing tax is lower than t^1_B so that the latter is unlikely to hold its tax rate at t^1_B.

For any given value of t_A, we can also define a myopic optimal tax rate for country B. Thus, if $t_A = t^2_A$, B's myopic optimal tax rate is $\tilde{t}^2_B$. As in the previous case, if B fixes its tax at $\tilde{t}^2_B$, A will want to choose a lower tax than t^2_A. It is evident that only at N is A's tax rate optimal given B's tax rate and vice versa. In this sense, N is the Nash equilibrium.

A final point which deserves noting is that it is entirely possible that the profits of <u>both</u> A and B can be higher at arbitrarily chosen tax rates (t^2_A, t^1B) than at Nash equilibrium. The problem with these arbitrary rates is, of course, that at least one country can increase its income by changing the tax rate. Therefore, the arbitrary rates are not sustainable under the Nash assumption. The lower profits at N than at some higher rates is simply the result of "tax-competition" between the two countries.

In our simulations, we extend the above model to allow for nine exporters. These exporters are Cameroon, Cote d'Ivoire, Ghana and Nigeria in Africa, Brazil and Ecuador in Latin America, Indonesia and Malaysia in Asia, and Oceania. Markets are assumed to be competitive in each country, and domestic consumption is assumed to be zero. We derive both the myopic optimal export taxes and Nash export taxes for each country.

We also employ the model to perform several comparative statics exercises. We simulate the effects of improvements in production efficiency in African and non-African countries on real income and tax revenues in the nine countries. The simulations are done both when tax rates are held constant and when they are altered endogenously (Nash taxes).

The world demand and country supply curves have been linearized by using existing elasticity estimates and 1986 prices and quantities. Knowledge of the elasticities is not sufficient to solve for the tax rates. The exact form of the various functions also matters. For instance, several studies have estimated demand functions in log form, and have obtained elasticity estimates smaller than one. Clearly, the elasticity cannot be smaller than one along the entire demand curve as this would imply an infinitely high optimal export tax at the world level.

The functional form is a matter which we plan to take up in the future. At this stage, we have assumed linear curves, which in the case of the demand function implies finite export taxes. Our results must thus be regarded as being preliminary. More definite results must await a more careful examination of the precise form of the demand and supply functions.

Trade policy interventions should be designed not to serve short-term stabilization objectives, but rather should be implemented in order to improve the long-term efficiency of resource allocation in those

specific cases where the market fails to do so.[7] Hence, long-term elasticity estimates were used as a basis for linearizing the supply functions. Thus, the simulations performed in the following section should be understood as generating comparisons between alternative long-run equilibria after all relevant planting changes have taken place.

Moreover, since we are concerned with the long-run we abstract from the demand for stocks and focus on consumption demand. We assume for simplicity that the residual output exported by the small producers - those not included in our group of nine major producers - is given and does not respond to changes in the world price. We then set the demand at the world price equal to the exports of the nine major producers. Finally, we abstract at this stage from the possibility of smuggling, say between Ghana and Cote d'Ivoire. This added constraint on the power of some countries to set export taxes will be taken up at a later stage.

Table 1 presents some of the basic data used in the analysis. The output levels (in thousands of metric tons)and the shares correspond to 1986, with the Cote d'Ivoire at 585 (36%), Brazil at 329 (20%), Ghana at 219 (13%), Malaysia at 125, (8%), Cameroon at 118 (7%), Nigeria at 110 (7%), Ecuador at 85 (5%), Indonesia at 32 (2%), and Oceania at 30 (2%). Table 1 also shows the 1986 world price, tax rate,[8] and domestic prices, the long-run supply elasticities and the corresponding slopes and intercepts of the long-run supply curves.

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[7] Power to affect the price in the market for a country's exports of a competitively produced commodity is a case where optimal export taxes will raise welfare for the exporting country.

[8] The tax rates correspond to 1982 and 1983. Reliable estimates of export tax rates for 1986 were not available.

The highest export tax rate (70%) corresponded to Ghana, followed by Nigeria (50%), Cameroon (40%), Côte d'Ivoire (25%), Brazil (20%), and a zero tax rate for Malaysia, Ecuador, Indonesia and Oceania. The more recent producers, Malaysia and Indonesia, have a high long-run supply elasticity (3), while those of traditional producers - like Ghana (0.71), Côte d'Ivoire (1.15), Nigeria (0.45) and Brazil (0.58) - are significantly lower.

World supply is 1633 and the world price is 2070. The elasticity of demand is 0.4, the intercept is 2286.3 and the slope is -315.6 M.T. per U.S. dollar.

III. SIMULATION RESULTS

In this section, we perform five sets of simulations. This will allow us to examine the effects of some of the recent changes in the cocoa market under actual taxes and compare them with the effects in the case where countries choose Nash taxes. We also examine the effects under "myopic" taxes.

The simulations are as follows:

1. First, we compare outputs and profits under actual taxes with those under free trade, Nash taxes and myopic taxes. (see Tables 2 and 3).

2. Second, we simulate an exogenous outward shift in Ghana's supply curve of 100,000 tons (MT), and examine the results under actual and Nash taxes (see Table 4).

3. Third, we simulate an exogenous shift in Malaysia's supply curve of 100,000 M.T. (see Table 5).

4. Fourth, we simulate the impact of elimination of the export tax in Cote d'Ivoire (see Table 6).

5. Finally, we simulate the impact of 2-4 above simultaneously (see Table 7).

1. Table 2 shows the tax rates, outputs and total profits (or income) under actual taxes and free trade. The results on output are presented in thousands of metric tons, and those on profits (and revenues in the other tables) are in millions of U.S. dollars.

The actual world price is 2,070, while under free trade it is 1,562 or 24.5 percent lower. Hence, output falls for countries with an initial tax rate below 24.5 percent (all five Non-African countries) and rises in the countries with an initial tax rate above 24.5 percent (all four African countries). The fall is largest in the countries with high elasticity (by 74% in Malaysia, 75% in Indonesia and 77% in Oceania). Output increases by over 100 percent in Ghana (the domestic producer price increases by over 150%, from 621 to 1562, and the elasticity is .71). Africa's output increases by over 30 percent (from 1032 to 1349), world output increases by about 10 percent (from 1633 to 1793), and Africa's share increases from 63 percent to 75 percent.

Profits, on the other hand, fall everywhere. They fall most for the small producers with elastic supply (by 93% in Malaysia, by 93.6% in Indcnesia and by 94.5% in Oceania). The fall in profits is also significant in Côte d'Ivoire (42.6%), in Cameroon (37.7%), in Brazil (31.9%), in Ecuador (27.9%) and in Nigeria (24.8%). The only country where the fall in profits is negligible is Ghana. Both the actual tax rate of 70 percent and the zero tax rate are sub optimal. In fact, we show below that the optimal (myopic or Nash) tax rate lies between these two extremes.

Profits for Africa fall from 1443 to 1043 (or by 27.7%), and world profits fall from 2182 to 1512.3 (by 30.7%). Thus, even though Africa's output (and share in world output) would rise under free trade, it would come at the expense of a reduction in profits.

Table 3 presents the initial results with actual, Nash and myopic taxes. Let us first consider myopic taxes. For a given country, this tax is derived by maximizing profits under the assumption that other rates are held fixed at their current (actual) levels. In terms of Figure 2, if B's tax is frozen at t^1_B, A's myopic tax is given by $\tilde{t}^1_A$. In Table 3, if tax rates of countries other than Côte d'Ivoire are kept at the levels shown in column (1), Côte d'Ivoire's (myopic) optimal tax is 29.9% (column 2'). Similarly, if tax rates of countries other than Ghana are held at the levels shown in column (1), Ghana's myopic optimal tax is 20.5% (column 2').

In contrast with myopic taxes, Nash taxes allow other countries to adjust their taxes optimally. Thus, for each country, the tax rate in column (2) is optimal when other countries choose tax rates at levels shown in the same column. In contrast to myopic taxes, Nash taxes do not leave room for profit-increasing changes in tax rates for any country as long as the others keep their taxes at Nash levels.

Not surprisingly, as seen by comparing columns (5) and (6'), each country taken one at a time can increase its profits under myopic taxes. But while this country maximizes profits, others do not do so under the myopic tax assumption. Reactions by others will eventually lead to the Nash equilibrium.

The most interesting comparison is between actual and Nash taxes. A striking result here is that profits under actual taxes are higher than under Nash behavior for all countries except Ghana. With as many as nine participants in the market, Nash behavior leads to excessive tax competition and results in lower profits for all participants except one. Also, as expected, profits under Nash taxes are larger than under free trade for all countries (compare column (5) in Table 2 and column (6) in Table 3).

The world price under Nash taxes is lower by U.S. dollars 291 per metric ton (MT) than under actual taxes, falling from 2070 to 1779 or by 14.1 percent. This is due to the substantial fall in tax rates for several producers: from 70% to 19.5% for Ghana, from 50% to 5.7% for Nigeria, and from 40% to 8.2% for Cameroon. These lower Nash tax rates result in substantially higher output for Ghana (from 219 to 421), Nigeria (from 110 to 139), and Cameroon (from 118 to 184).

The Nash taxes are somewhat lower than actual taxes for Brazil (13.5% versus 20%), they are not substantially different from actual taxes for Cote d'Ivoire (25.2% versus 25.1%), and they rise from zero to 3.2% for Ecuador, to 2.8% for Malaysia, to .7% for Indonesia and to .6% for Oceania. Cote d'Ivoire's output falls by 16.3% (from 585 to 490) because of the 14.1% fall in the world price, combined with a long-run supply elasticity slightly larger than one. The outputs of Malaysia, Indonesia and Oceania fall by about 50 percent (a combination of the 14.1% fall in the world price, a small rise in the tax rate and an elasticity of 3).

World output rises from 1633 to 1725 (by 5.7%). Hence consumers in developed countries gain from the lower world price and higher output. Africa's output under existing taxes is 1032 and its share is 63.2 percent. Under Nash taxes, Africa's output rises to 1234 or by 19.6%, and its share rises to 71.5 percent, or by 8.3 percentage points.

One of the concerns for Africa has been the fall in its share of world cocoa exports, and the rise in the share of Malaysia and Indonesia. A Nash strategy would have resulted in a higher share for Africa, as well as in a fall in the share of Malaysia from 7.7% to 3.6%, and in a fall in the share of Indonesia from 2.0% to 1.0%. Such an expansion for Africa would have come at the cost of lower profits, however.

Profits under Nash taxes, in millions of US dollars, increase by 88 in Ghana (or by over 20%), and fall by 202 (29%) in Côte d'Ivoire, by 99 (19.2%) in Brazil, by 29 (67.4%) in Malaysia, by 25 (16.5%) in Ecuador, by 20 in Nigeria (10%), by 13 (9.4%) in Cameroon, and by about 8 (69.7%) in Indonesia and Oceania (70.7%). Overall profits fall by 315 or by 14.4 percent. Profits in Africa fall from 1443 to 1296 or by 10.2 percent. Africa's share in total profits rises by three percentage points (from 66.5% to 69.5).

The beneficiaries from Nash taxes rather than actual taxes are the cocoa consumers and Ghana, while the other producers lose. The main losers, in terms of the proportional fall in profits, are Oceania, Indonesia, Malaysia and Cote d'Ivoire.

Government revenues increase slightly in Ecuador, Malaysia, Indonesia and Oceania, and they fall everywhere else. They fall by 87

percent in Nigeria, 72 percent in Cameroon, 53 percent in Ghana, 46 percent in Brazil and 27 percent in Côte d'Ivoire. The proportional fall in revenues is directly related to the reduction in tax rates.

These results are preliminary. Assuming that they hold after careful econometric analysis is done, it would lead us to conclude that when providing policy advice to any one country in the case of commodities such as cocoa, the various bilateral and multilateral donors should take into account both the effect on other countries as well as their possible reaction to the recommended policy change. This would help avoid a potentially undesirable outcome such as the Nash solution where most countries end up worse off despite the expectation of a welfare improvement. Even if some countries gain - such as Ghana in this case - the actual gain would be substantially lower than what might have been expected based on the assumption that myopic taxes in various countries are mutually consistent.

Joint optimization by cocoa producers would of course result in higher taxes, lower output, a higher world price and higher overall profits. This strategy is not examined in the simulations because it does not appear to us to be a sustainable one. Agricultural commodities differ from mineral resources (such as oil) in on important respect. The latter's output is predictable, while output of the former is volatile. It is hard to believe that a country experiencing a bumper crop will simply accept the export quota determined by the joint maximization strategy. For instance, we saw recently that even with the support of the consumer countries, the International Coffee Agreement fell apart.

2. The effects of a 100,000 M.T. outward shift in Ghana's supply curve under both sets of taxes are shown in Table 4. The difference in the effects of actual and Nash taxes in this case are very similar to those in the original case (Table 3). Hence, we first compare the results in the original case and in the present case when actual taxes are levied. The comparison of results when Nash taxes are used is similar and is briefly discussed later.

Clearly, Ghana gains from the exogenous productivity increase. Its profits rise from 405 to 579 (see column 5 in Tables 3 and 4) under actual taxes. The increased productivity in Ghana leads to a fall in the world price, from 2070 to 1993 (or 3.7%).

The lower world price implies a loss in profits in all other countries. The loss is 56 in Cote d'Ivoire (8.%), 28 in Brazil (5.3%), 17 in Cameroon (12.3%), 11 in Nigeria (5.7%), 7 in Ecuador (4.6%), 9 in Malaysia (20.9%), 2.7 in Indonesia (24.5%) and 3.3 in Oceania (30%).

Interestingly, the overall profits for the nine countries change very little. They rise only from 2182 to 2222, or by 1.8 percent. In other words, even though Ghana gains from the increase in its productivity, the losses by the other countries are such that overall industry profits remain practically unchanged. Ghana gains 174, while the other countries lose 134, so that overall profits increase by 40. Hence, the principal gainers from Ghana's increase in productivity are Ghana and the consumers who benefit from a lower price.

Africa's profits increase from 1443 to 1533, and its share in total profits rises from 66.1 percent to 69 percent. Non-Africa's

profits fall from 739 to 689, and its share falls from 33.9 percent to 31 percent.

The lower world price leads to a reduction in output in all countries except Ghana (given the unchanged tax rates), and world output increases by 26 (from 1633 to 1659, see column 3 in Tables 3 and 4), i.e., by one quarter of the shift in Ghana's supply curve. Total revenues fall for all countries with positive tax rates other than Ghana because of a lower output and lower world price.

Interestingly, in the case of Nash taxes, producers as a whole are able to retain more profits from Ghana's productivity increase than in the case of existing taxes, even though world prices are lower in the former case. Under Nash taxes (see column 6, Tables 3 and 4), overall profits rise by 53.2 (from 1866.6 to 1919.8), while under existing taxes (column 5, Tables 3 and 4), they only rise by 40. Also, Nash tax rates in this case are similar to those in the original case for all countries except for Ghana, whose Nash tax rate increases from 19.5 percent to 23.5 percent.

In this case, under existing taxes, Africa as a whole gains about half (90) of what Ghana gains (174), while all producers gain about 23 percent (40) of what Ghana gains. These findings are again preliminary. If they hold under closer empirical scrutiny they would lead us to conclude that when considering the financing of investment projects in commodities such as cocoa, bilateral and multilateral donors should take into account the negative impact on the other producers. Moreover, simultaneous expansion of output in several countries would not generate the returns on the investment projects which would result from output

expansion in one country only. These points were raised in an a somewhat different context in an early paper by Goreux (1972).[9] The World Bank policy of denying lending for output expansion in commodities such as cocoa (except in special circumstances) is based on the above considerations.

3. The effects of a 100,000 M.T. outward shift in Malaysia's supply curve are quite similar to those when the shift occurs in Ghana's supply curve, and are shown in Table 5. In the case of existing taxes, the effects are identical for all countries other than Ghana and Malaysia. World supply in both cases is 1659 and the world price is 1993. In the present case, Ghana's profits fall from 405 to 380 (and its output falls form 219 to 213), while Malaysia's profits rise from 43 to 123 (and its output rises from 125 to 211).

World profits are lower (2112) in this case than in the case where Ghana's supply shifts outward (2222). The reason is that in the present case, Ghana's output is lower (than when the supply shift occurs in Ghana) by 100, while Malaysia's output is higher by 100 (see Tables 4 and 5, column 3), and Ghana is the lower-cost producer. As is shown in Table 1, at the actual outputs, Ghana's producer price (and marginal cost) is 621 while that of Malaysia is 2070.

In fact, the outward shift in Malaysia's supply curve leads to overall immiserization for the exporting countries as a whole. Total profits fall to 2112, compared to 2182 in the actual case. Hence, even

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9 Goreux examined the returns on investment projects alternatively from the viewpoint of the firm, of the investing country, of all producing countries, and of the world as a whole.

though Malaysia's profits rise by almost 200 percent, total industry profits fall. Comparing the present case with that when Ghana's supply shifts outward (with world output and price being the same in both cases), the reason for which profits are only 2112 rather than 2222 is that a larger share of the given total output is produced by a higher-cost producer (Malaysia) rather than by a lower-cost producer (Ghana).

Africa's profits in this case are 1334 out of a total of 2112, so that its share is 63.2 percent. That compares with the higher profits (of 1443) in the actual case (and a share of 66.1%), and profits of 1533 (share of 69%) when Ghana's supply curve shifts outward.

In the case of Nash taxes, tax rates in the present case in all countries other than Ghana and Malaysia are extremely close to the tax rates when the supply shift occurs in Ghana. The tax rates for Ghana and Malaysia are quite different in each case. In the present case, Ghana's Nash tax rate is 19.7 percent and that of Malaysia is 6.6 percent. When Ghana's supply shifts outward, the Nash tax rates are 23.5 percent for Ghana (i.e., 3.8 percentage points higher) and 2.5 percent for Malaysia (4.1 percentage points lower).

With Nash taxes, profits for all countries other than Ghana and Malaysia are extremely close in both cases. Malaysia's profits rise from 10 (when Ghana's supply shifts outward) to 70 in the present case, while Ghana's profits fall from 631 to 463. Total industry profits in the present case are 1804.6 rather than 1866.6 in the original cae, i.e., they fall by 62. However, with existing taxes, they fall from 2182 to 2112 or by 70. Hence, the use of Nash taxes enables the

industry as a whole to suffer smaller losses from the supply shift than with existing taxes.

Thus, Africa as well as the industry as a whole loses both with actual and Nash taxes. This would seem to reinforce the point made earlier that donors should take into account the interdependencies among producing countries when assessing investment projects.

4. Up to mid-1989, the Caisse de Stabilisation in the Côte d'Ivoire did not pass on the significant reduction in world cocoa prices to its producers. The Caisse was still paying the producers more than the price it obtained (net of marketing costs). It was paying 400 CFA/MT, implying a cost for the Caisse of well over the FOB price of 500 CFA/MT. We simulate the reduction in Côte d'Ivoire's export tax rate by setting it equal to zero and keeping the tax rates of the other countries at their initial level. This is shown in Table 6.

We notice a dramatic increase in Côte d'Ivoire's output, from 585 to 739, or by 26.3 percent. The world price falls from 2,070 to 1,905 or by 8 percent, so that all ccuntries other than Côte d'Ivoire lose. However, Côte d'Ivoire also loses as its profits fall from 698 to 629, or by 10 percent. Hence, the strategy followed by Côte d'Ivoire was certainly not optimal from its own viewpoint (unless the Caisse aimed to stabilize the producer price and believed that the changes leading to a fall in the world price were transitory). With its large share in the world market, a zero tax rate does not maximize profits.

5. Finally, we examine the impact of the three previous simulations simultaneously, i.e., a 100,000 M.T. supply shift in Ghana and Malaysia and a zero export tax rate in Côte d'Ivoire. The results are shown in Table 7. The output of Côte d'Ivoire rises from 585 to 673 because of the fall in its tax rate (but rises by less than under the previous simulation), and it rises for Ghana and Malaysia because of the supply shift. Output falls in all other countries. Total output rises from 1633 to 1732, and the world price falls from 2070 to 1754 (by 15.3%). Profits fall in all countries except Ghana and Malaysia. Total profits and Africa's profits also fall.

IV. Concluding Comments

The results presented in this paper are preliminary. The demand and supply functions were linearized based on point estimates of the relevant parameters. The exact form of these functions is crucial in determining the equilibrium tax rates, outputs, profits and revenues. In future work, we plan to closely examine the form of the relevant functions. We will also examine the properties of other Nash equilibria. These include revenue-maximizing Nash taxes, and using export quotas rather than the export tax as the policy variable. Our findings so far seem to suggest that in providing policy advice and support of investment projects in the case of commodities such as cocoa, the donor community should take into account the effects on and possible reactions of the other producing countries.

For instance, our analysis indicates that increasing productivity in one African country, resulting from new investments, would benefit

the country in question. The other African countries would lose. However, it would seem that the African countries as a whole would benefit, so that the gains to the country whose output expanded would dominate the losses for the other countries. Hence, the return on the new investments would be positive for Africa as a whole but they would undoubtedly be significantly lower than for the country in question.

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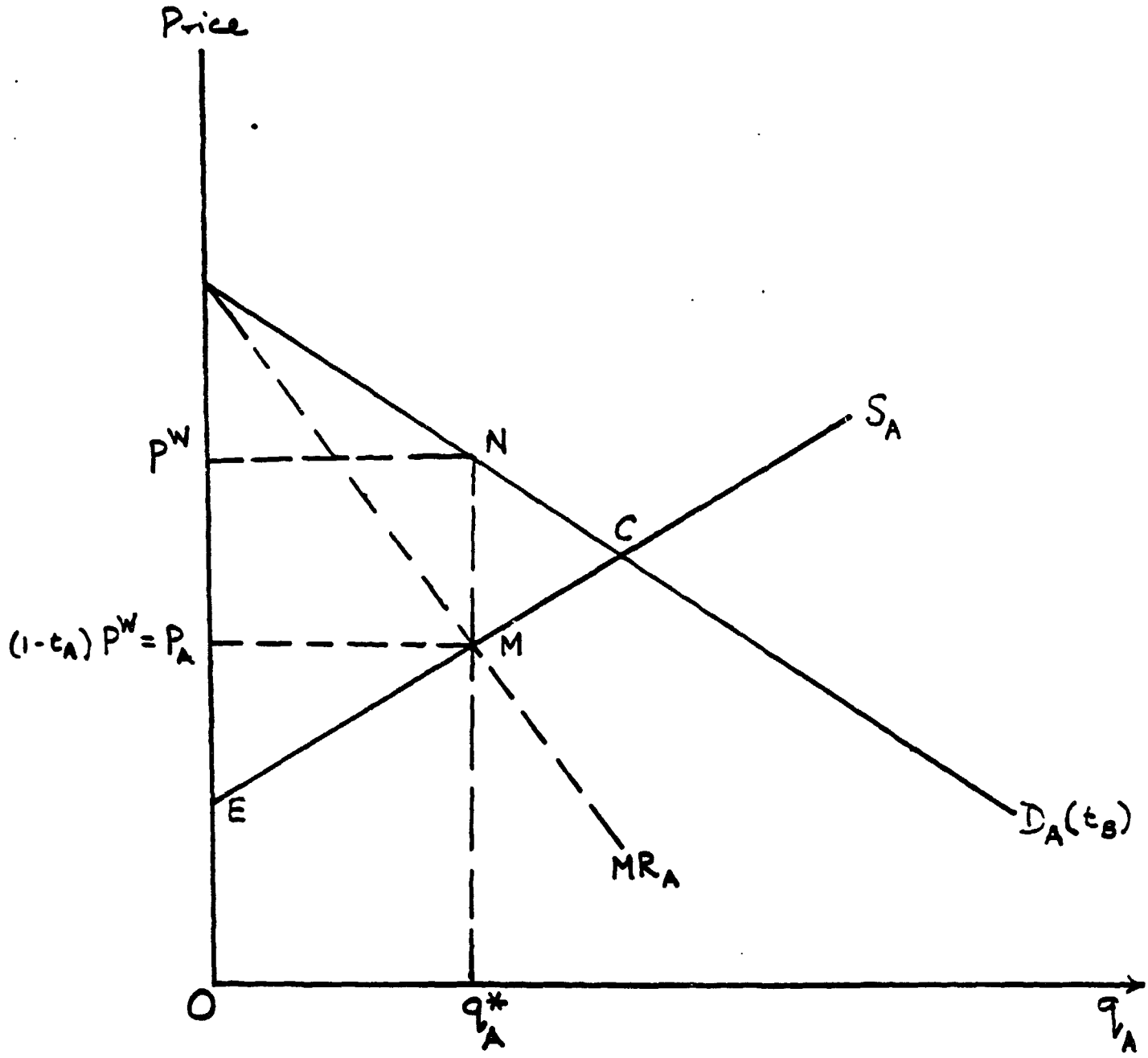

Figure 1

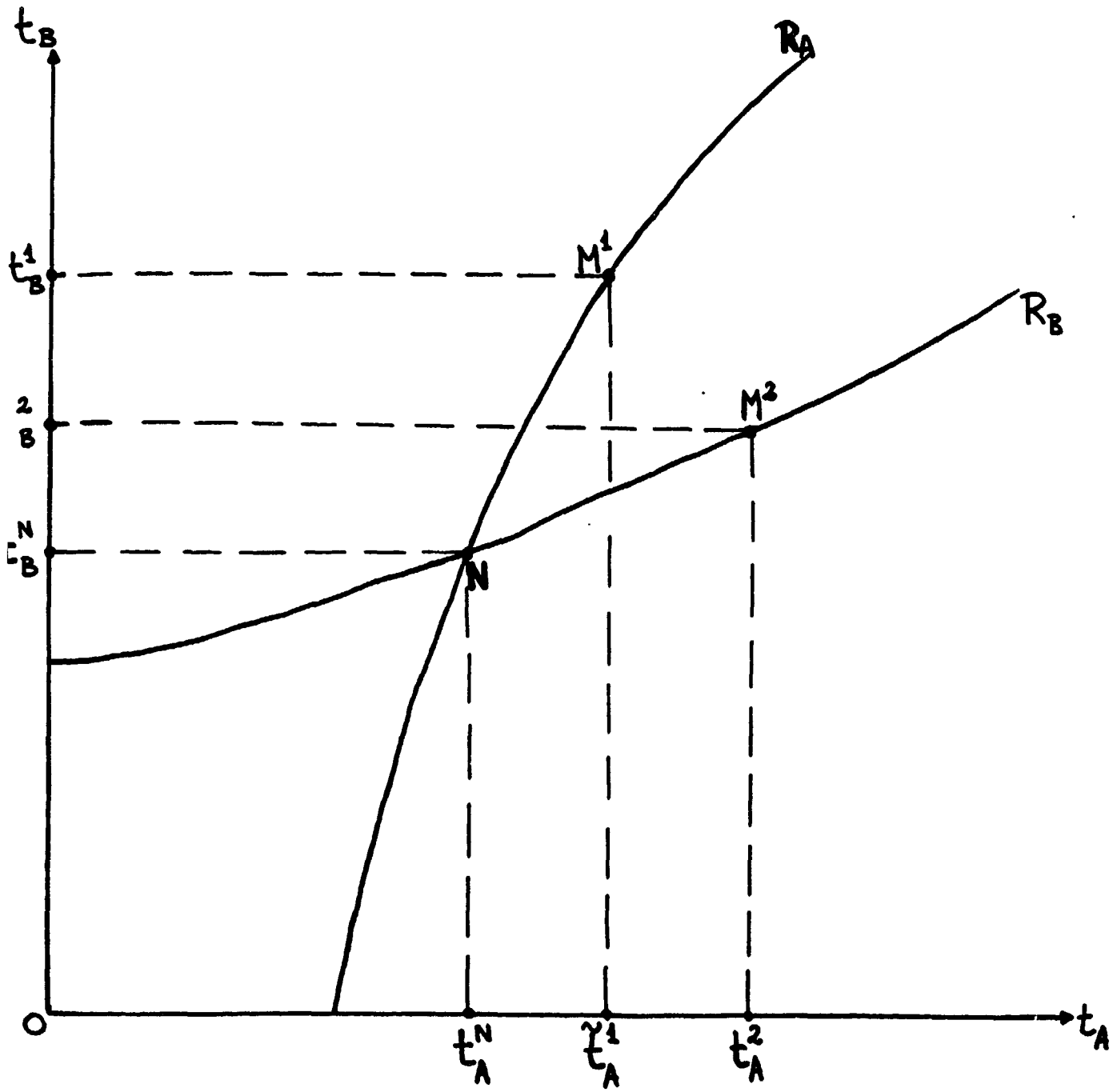

FIGURE 2.

TABLE 1. BASIC DATA

	OUTPUT (000MT)	OUTPUT SHARE (%)	EXPORT TAX (%) a/	DOMESTIC PRICE (US$/MT)	ELASTICITY b/	SLOPE c/	INTERCEPT (000MT)
COTE D'IVOIRE	585	35.8	25.1	1550	1.15	0.434	-87.7
GHANA	219	13.4	70.0	621	0.71	0.250	63.5
CAMEROON	118	7.2	40.0	1242	1.81	0.172	-95.6
NIGERIA	110	6.7	50.0	1035	0.45	0.048	60.5
MALAYSIA	125	7.7	0.0	2070	3.00	0.181	-250.0
INDONESIA	32	2.0	0.0	2070	3.00	0.046	-64.0
OCEANIA	30	1.8	0.0	2070	3.00	0.043	-60.0
ECUADOR	85	5.2	0.0	2070	0.28	0.011	61.2
BRAZIL	329	20.1	20.0	1656	0.58	0.115	138.2

(a) The non-zero export tax rates are from Imran and Duncan, Table 7, page 21, and refer to 1982 and 1983 (for Brazil).
(b) The long-run elasticities for Brazil, Cote d'Ivoire, and Malaysia were obtained from Akiyama and Bowers, page 25. They apply to ten-year periods, using the highest production levels to obtain those values. We assume that the elasticities of Indonesia and Oceania are equal to that of Malaysia. The other elasticities are from Behrman.
(c) The slope is the change in metric tons for a one US dollar change in the domestic producer price.

Table 2. Initial Results with Actual Taxes and Free Trade.

Country	Tax Rates (%) Actual (1)	Output (000MT) Actual (2)	Output (000MT) Free Trade (3)	Profit[1] (Millions of U.S. dollars) Actual (4)	Profit[1] (Millions of U.S. dollars) Free Trade (5)
Cote d'Iv.	25.1	585	590	698	401
Ghana	70.0	219	454	405	404
Cameroon	40.0	118	171	138	86
Nigeria	50.0	110	134	202	152
Africa		1032	1349	1443	1043
Malaysia	0.0	125	33	43	3
Indonesia	0.0	32	8	11	.7
Oceania	0.0	30	7	11	.6
Ecuador	0.0	85	78	151	109
Brazil	20.0	329	318	523	356
World		1633	1793	2182	1512.3

World Price (U.S. dollars / MT)

Actual: 2,070
Free Trade: 1,562

[1]Profits are defined to include producers' surplus and government revenue. Actual profits are derived by assuming that the calibrated demand and supply curves are true demand and supply curves. These profits will be different in general from actual observed profits (inclusive of tax revenues).

Table 3. Initial Results with Actual, Nash and Myopic Tax Rates

	Tax Rates (%)			Output (000MT)		Profit[1] (Millions of U.S. dollars)			Revenue (Millions of U.S. dollars)	
	Actual	Nash	Myopic	Actual	Nash	Actual	Nash	Myopic	Actual	Nash
Country	(1)	(2)	(2')	(3)	(4)	(5)	(6)	(6')	(7)	(8)
Cote d'Iv.	25.1	25.2	29.9	585	490	698	496	705	304	220
Ghana	70.0	19.5	20.5	219	421	405	493	544	318	146
Cameroon	40.0	8.2	9.8	118	184	138	125	172	98	27
Nigeria	50.0	5.7	6.3	110	139	202	182	221	114	14
Africa				1032	1234	1443	1296		834	407
Malaysia	0.0	2.8	5.1	125	63	43	14	44	0	3.2
Indonesia	0.0	0.7	1.2	32	17	11	3.4	11.3	0	.2
Oceania	0.0	0.6	1.3	30	16	11	3.2	11.1	0	.2
Ecuador	0.0	3.2	3.3	85	80	151	126	152	0	4.6
Brazil	20.0	13.4	14.7	329	315	523	424	525	136	75
World				1633	1725	2182	1866.6		970	490.2

World Price (U.S. dollars / MT)

Actual: 2,070
Nash: 1,779

[1]Profits are defined to include producers' surplus and government revenue. Actual profits are derived by assuming that the calibrated demand and supply curves are true demand and supply curves. These profits will be different in general from actual observed profits (inclusive of tax revenues).

Table 4. Increasing Ghana's Intercept by 100,000MT

Country	Tax Rates (%)		Output (000MT)		Profit (Millions of U.S. dollars)		Revenue (Millions of U.S. dollars)	
	Actual (1)	Nash (2)	Actual (3)	Nash (4)	Actual (5)	Nash (6)	Actual (7)	Nash (8)
Cote d'Iv.	25.1	25.3	560	470	642	460	280	205
Ghana	70.0	23.5	313	492	579	631	437	200
Cameroon	40.0	8.1	109	175	121	114	87	24
Nigeria	50.0	5.8	107	137	191	173	107	14
Africa			1089	1274	1533	1378	911	443
Malaysia	0.[illegible]	2.5	111	53	34	10	0	2.3
Indonesia	0.0	0.6	28	15	8.3	2.5	0	.2
Oceania	0.0	0.6	26	14	7.7	2.3	0	.1
Ecuador	0.0	3.3	83	79	144	122	0	4.6
Brazil	20.0	13.7	322	309	495	405	128	73
World			1659	1744	2222	1919.8	1039	523.2

World Price (U.S. dollars / MT)

Actual: 1,993
Nash: 1,722

Table 5. Increasing Malaysia's Intercept by 100,000MT

Country	Tax Rates (%)		Output (000MT)		Profit (Millions of U.S. dollars)		Revenue (Millions of U.S. dollars)	
	Actual (1)	Nash (2)	Actual (3)	Nash (4)	Actual (5)	Nash (6)	Actual (7)	Nash (8)
Cote d'Iv.	25.1	25.2	560	470	642	457	280	203
Ghana	70.0	19.7	213	408	380	463	297	138
Cameroon	40.0	8.1	109	174	121	113	87	24
Nigeria	50.0	5.8	107	136	191	172	107	14
Africa			989	1188	1334	1205	771	373
Malaysia	0.0	6.6	211	140	123	70	0	16
Indonesia	0.0	0.6	28	14	8.3	2.4	0	.1
Oceania	0.0	0.6	26	13	7.7	2.2	0	.1
Ecuador	0.0	3.3	83	79	144	121	0	4.5
Brazil	20.0	13.7	322	309	495	404	128	73
World			1659	1743	2112	1804.6	899	467

World Price (U.S. dollars / MT)

Actual: 1,993
Nash: 1,717

Table 6. Comparing the Initial Equilibrium and the Effect of Fixing Cote d'Ivoire's Tax at Zero.

	Tax Rates (%)		Output (000MT)		Profit (Millions of U.S. dollars)		Revenue (Millions of U.S. dollars)	
	Original	New	Original	New	Original	New	Original	New
Country	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cote d'Iv.	25.1	0.0	585	739	698	629	304	0
Ghana	70.0	70.0	219	206	405	352	318	275
Cameroon	40.0	40.0	118	100	138	105	98	76
Nigeria	50.0	50.0	110	105	202	179	114	100
Africa			1032	1150	1443	1265	834	451
Malaysia	0.0	0.0	125	95	43	70	0	0
Indonesia	0.0	0.0	32	24	11	2.3	0	0
Oceania	0.0	0.0	30	22	11	2.1	0	0
Ecuador	0.0	0.0	85	82	151	120	0	0
Brazil	20.0	20.0	329	313	523	396	136	119
World			1633	1686	2182	1855.4	970	570

World Price (U.S. dollars / MT)

Original: 2,070
New: 1,905

Table 7. Comparing the Initial Equilibrium and the Effect of Fixing Cote d'Ivoire's Tax at Zero and Increasing the Intercepts of Ghana and Malaysia by 100,000MT.

	Tax Rates (%)		Output (000MT)		Profit (Millions of U.S. dollars)		Revenue (Millions of U.S. dollars)	
	Original	New	Original	New	Original	New	Original	New
Country	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cote d'Iv.	25.1	0.0	585	673	698	522	304	0
Ghana	70.0	70.0	219	295	405	483	318	362
Cameroon	40.0	40.0	118	84	138	80	98	59
Nigeria	50.0	50.0	110	102	202	160	114	89
Africa			1032	1154	1443	1245	834	510
Malaysia	0.0	0.0	125	167	43	77	0	0
Indonesia	0.0	0.0	32	17	11	3.0	0	0
Oceania	0.0	0.0	30	15	11	2.8	0	0
Ecuador	0.0	0.0	85	80	151	124	0	0
Brazil	20.0	20.0	329	299	523	412	136	105
World			1633	1732	2182	1863.8	970	615

World Price (U.S. dollars / MT)

Original: 2,070
New: 1,754

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